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Observations on a Mature Giant Sequoia at the Big Stump Entrance Station, Kings Canyon National Park

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On September 20, 2005, I joined Tom Warner (Park Forester) and the Forestry Crew at the Big Stump entrance station on California Highway 180. The purpose of this visit was to examine an old growth giant sequoia located close the entrance station kiosk and determine its structural soundness.

Tree Condition:

Based on measurements made by Park personnel, the tree is 17 feet in diameter at breast height (DBH). The original bole broke off at an unknown time at a height of 105 feet. There is no evidence of the original top in the area. A very large and deep fire scar is present on the south side (uphill) of the tree and is 20 feet wide at soil line, which is almost equal to the tree's diameter at this point. The scar extends to a height of 60 feet. Above 60 feet the outer bole is intact but hollow. The tree has a slight lean (2 degrees) along a bearing of 354 degrees, which is in the direction of the entrance kiosk.

Live branches occupy the upper portion of the original bole beginning at a height of approximately 50 feet and extending up to the top of the bole. The largest branches (3-4 feet in diameter) are near the top of the bole and some have turned up to become vertical leaders. The tallest leader is 75 feet in length, making the total tree height about 180 feet.

Inside the burned out cavity, brown rot decay was present behind the surface of the fire scar to a depth of 6 or more inches. Decay began below the soil line and extended up through the entire height of the original bole. Using a Resistograph® and cordless drill we determined that the tree typically had between 8 and 10 inches of bark near ground line. Neither bark nor decayed wood provide any structural strength to the tree. Bark thickness near the edge of the fire scar at a height

of about 55 feet was 4-6 inches. Behind this bark we found as little as 7 inches of sound sapwood. The upper bole where branches are attached was estimated to be 12 feet in diameter inside bark. Using existing and accepted strength loss formulas, a bole this size should have a minimum of 21 inches of sound sapwood around the outer circumference to meet safety standards. The preceding information was gathered using the Park's boom truck, and I was not able to examine the tree above 55 feet.

Discussion and Conclusions

The history of giant sequoia failures based on the Park's records show that green branch failures, associated with snow loading and wind, account for the great majority of accidents (88%). Root failures are second in occurrence with 8% and stem failures last at 4%.

Research completed in the 1970s investigating whole-tree giant sequoia failures found that annosus root disease, caused by *Heterobasidion annosum*, was the most common root pathogen associated with fallen sequoias. This root disease is found throughout the forested mountains of California, including Sequoia-Kings Canyon National Park and can spread from white fir stumps to living giant sequoias. We found no evidence, however, that *H. annosum* is active in the vicinity of the examined tree. Still, the amount of wood missing at the base of the tree due to fired damage and decay represents a clear reduction in strength and stability. Structural roots below the fire scar are likely either completely dead and decayed or partially damaged with decay.

No one can accurately predict what type of failure will take place, or when. All of the observations of this tree and available background information indicate that it could fail at the roots, upper bole or branches. Green branch failures have the highest likelihood of occurrence. Normally we would expect root failure to be the second most likely followed by bole failure. However, because of the extensive amount of wood lost in the upper bole and resulting thin shell of sound wood supporting much branch weight, the probability of a bole failure may be equal to that of a root failure.

This giant sequoia has numerous and serious defects that warrant immediate attention. Over time the probability of failure will only increase.

Management Options

Standard alternatives for addressing hazard tree situations include the following:

1. **Do nothing**. The implication here is that management is willing to accept the risk by taking no action. This is a legitimate approach when target values and the probability of failure are low to moderate and the need for mitigation is not clear. It also assumes that the tree will be closely monitored for any changes in its condition. This is not an acceptable option in the current situation because the target value is high (when buildings

are occupied or visitors present) and the probability of tree failure is moderate to high (depending on the type of failure – branch, bole or root).

2. **Treat the tree to reduce hazard potential**. Removing selected branches and leaders would reduce the total weight of the crown, and the proper distribution of weight could offset the tree's lean. This would lower the probability of branch, bole and root failures. An experienced arborist would have to provide direction on which and how much crown material to take out. Removing the entire tree is also an option that would completely eliminate hazard potential.

3. **Move the target**. Finding different locations for the entrance kiosk, other Park Service buildings and vehicle parking areas outside the striking distance of the giant sequoia is the final management option.

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